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Effect of Planting Scheme on Fruit Quality and Yield of Apple Cultivars in Intensive Orchards

Fayziyev Jamolidin Nasirovich [1], Boboyeva Xilola Abduraxmonovna [2]

[1, 2] Research Institute of Horticulture, Viticulture and Winemaking named after Academician Makhmud Mirzaev, 111118 Tashkent, Uzbekistan

Annotation: The article presents information on the study of the influence of the planting scheme on the fruit quality and yield of apple varieties, local apple varieties "Oydin", "Rustamiy", "Israel", "Nafis" and introduction Williams Pride, Dayton, Vadimovka, Prikubanskoe, King David, Florina, Starking Delishes, Sunprice, Kubanskaya bagrennaya, Goldrash in a plot of 4.0x2.0 m the fact that the marketability indicators of the fruits when planting are high, due to the increase in the size of the fruits, the weight increased by 1.3-9.7%, the sugar content of the fruit increased by 0.1-1.1%, and the amount of organic acids decreased by 0.1-0.2%. Also, the yield of these varieties was the highest 34.0-49.4 t/ha when planted in a 4.0x2.0 m scheme.

Keywords: intensive, garden, planting scheme, variety, fruit, chemical composition of fruits, water, sugar, dry matter, acidity, tree, productivity.

Introduction. It takes 15-20 years to fully cover the costs of building and maintaining an extensive garden. Therefore, the transition of orchards to an intensive type is recognized by the world community.

Selection of introduced and local varieties for intensive gardens in the soil-climatic conditions of Uzbekistan, development of effective elements of agro-technologies of their cultivation is an urgent task. In recent years, in this regard, a number of measures have been implemented in the republic on the technologies of intensive cultivation of apple orchards. In particular, the Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PD-60 on the development strategy of New Uzbekistan for 2022-2026 «...grow exportable products and develop fruits and vegetables, triple the area of intensive gardens and double the number of greenhouses, increasing the export potential to another billion US dollars…[1].» is highlighted as one of the priorities.

The reason for the transition of world horticulture to high-density, early and high-yielding orchards was the economic performance of these orchards. It is important to evaluate the efficiency of land use in production and the quick return of spent funds. Planting costs in intensive orchards are 1.5 times higher than in extensive orchards, but the price of 1.0 t of fruit is 2 times lower in them. [10; 3–81-p.], [7; 49–59-p.].

The problem of rational use of garden space can be successfully solved by increasing the number of fruit trees per unit area. Low-growing varieties to maximize tree density per unit area, maintenance of small-sized trees (shaping, pruning branches and branches, treatment against diseases and pests, etc.) and the convenience of harvesting operations allows to increase the productivity by two or more times compared to traditional gardens [2; 103–117-p.], [8; 13–14-p.].

[1]https://lex.uz/docs/5841063

Research methodology: Studies on the impact of the planting scheme on fruit quality and yield of apple varieties were conducted in an intensive orchard planted in the low M-IX graft of apples in the soil and climate conditions of the Tashkent region in 2020-2022. According to the ripening period, 35 different varieties of apples were divided into summer, early autumn, autumn and winter groups.

The trees of apple varieties were grown in vertical symbags, shaped by the palmette method, and calculations and observations were made in 4 repetitions out of 5 trees in each option.

The quality of fruits is characterized by indicators such as its size, taste, evenness, production by varieties, harvest time, duration of freshness, chemical composition, and technological characteristics.

Average fruit weight - each experimental variant was determined on trees in each replicate, for which 200 fruits from the harvested crop were randomly selected, weighed, and the total weight was divided by 200.

Laboratory tools were used to analyze the biochemical composition of fruits of apple varieties: sugar content was determined in a refractometer, the amount of water and dry matter in fruit was determined in a fruit moisture analyzer, and acidity was determined in a fruit juice titration device.

Yield per tree was calculated from 4 replicates of 5 trees in each variant, and yield per hectare was calculated by multiplying the yield per tree by the number of trees per feeding area.

Statistical analysis of the research results in Excel 2010 and Statistica 7.0 for Windows computer programs, with a confidence interval of 0.95% was calculated according to the method by B.A. Dospekhov [6; 301–325 p.]

Research results and their analysis: The quality and chemical composition of fruits depends on many factors: geographical location of the garden, grafting, biological characteristics of the variety, tree planting scheme, agrotechnical activities carried out in the garden (watering, fertilizing, shaping) and fruit ripening period.

If we take into account the quality of the fruit, the size and color of the fruit, the maximum yield can be grown at a certain density. This conclusion applies mainly to those who want to increase the density of the tree and get a high yield [5; 411–422-p.].

When planting trees, it should be taken into account that the more trees are planted in one hectare, the greater the harvest. But this also has its limits. The factors that determine the border depend on the size of the trees, the way they are shaped, the level of mechanization in processing between the rows. Due to overcrowding of the trees, it has a negative effect on the quantity and especially the quality of the fruit [3; 138–142-p.].

In intensive orchards, the correct choice of the planting scheme depending on the width of rows and the strength of growth of trees in them, allows timely and high-quality agrotechnical activities, increasing the size and quality of fruits. The quality of the fruit depends on its size, shape and color. Its size is usually determined by its absolute weight. The size of the fruits of one variety depends on the graft, the age of the tree, productivity, soil-climate conditions and planting scheme.

The analysis of the effect of the planting scheme on the fruit size of the apple cultivars showed that the fruit weight decreased in all cultivars as the feeding area of the trees decreased compared to the control. This indicator was 149.7 g in the control 4.0x2.5 m scheme in the "Oydin" variety with a large size of the crown, and 164.3 g in the version planted in the 4.0x2.0 m scheme, and compared to the control It increased by 9.7%, and in the 4.0x1.0 m plot, fruit size decreased by 17.3% compared to the control. In the "Elena" variety, the fruit weight in the control plot was 159.8 g, while in the 4.0x2.0 m plot, the fruit indicator (169.0 g.) increased by 5.7%, and in the 4.0x1.0 m plot, it was found that it decreased by 13.5%. Fruit weight increased (2.7-4.4%) in the 4.0x2.0 m and 4.0x1.5 m schemes according to the feeding area, and decreased in the 4.0x1.0 m scheme compared to the control Pristin, Rustamiy, Williams Pride and « Pervenets Samarkanda»(st) varieties with an average index of 3.5-9.7%. The size of the fruits of Kyzil Jonaki, Dayton and Vadimovka varieties, which have a small size, increased by 1.1-1.3% in the 4.0x2.0 m and 4.0x1.5 m schemes compared to the

control, and in the 4.0x1.0 m scheme and in the sown variant it decreased by 1.3-2.0% with the smallest difference.

According to the strength of growth among varieties in the summer group (tree height, canopy size) The average increase in the size of the fruits in the variety Stark Erlist by variants in the 4.0x2.0 m and 4.0x1.5 m schemes compared to other varieties increased by at least 0.9-1.2%, and in the 4.0x1.0 m scheme it sharply was found that it decreased by 12,3%, this is explained by the fact that in this variety, the thick growth of the crown has a strong effect on the size of the fruits as the feeding area is reduced.

The effect of planting pattern on fruit quality is also different in early autumn apple varieties, in cultivars and hybrids, fruit weight decreased as the feeding area decreased compared to the control, In the "Israel" variety and II-X-31, II-X-11 hybrids, the fruit weight increased by 6.5-7.0% in the 4.0x2.0 m scheme compared to the control, while in the 4.0x1.0 m scheme 15.8-17.6% decrease was found. This indicator is at least 0.3-1.9% in most early autumn Renda, Kandil Sinap, "Bolajon", "Farangiz", Starking Delishes, Remo and Wagnera prizovoe varieties in 4.0x2.0 m and 4.0x1.5 m schemes has increased, and in the 4.0x1.0 m scheme it has decreased by at least 0.1-1.3%. Among the early autumn varieties, the weight of the fruits in the Limoni variety, which is distinguished from other varieties by its thick crown growth, increased by at least 0.3-0.2% in the 4.0x2.0 m and 4.0x1.5 m schemes, In the 4.0x1,0 m scheme, it was found that it decreased sharply by 9.4% (Table 1).

In autumn and winter cultivars, it was found that the reduction of the feeding area in comparison to the control led to a decrease in fruit weight. King David (st) (185.6; 183.1 g.), Florina (194.5; 193.4 g.), "Nafis" (st) (248.9; 244.9 g.) and Mutsu (285.9; 284.9 g.) fruit weight increased by 3.1-6.2% in the 4.0x2.0 m and 4.0x1.5 m schemes, and the most in the 4.0x1.0 m scheme It was found that it decreased by 3.8-7.5%. In this group, the Pamyat Esaolu and Goldrash varieties, which have a small crown size, increased by at least 0.9-1.9% in the 4.0x2.0 m and 4.0x1.5 m schemes compared to the control variant, In the 4.0x1.0 m scheme, it was found that it decreased by at least 0.8-1.6% (Table 2).

One of the indicators determining the quality of fruits is their chemical composition, which depends on the type and variety of fruits on the one hand, and on the other hand, their growth conditions. The abundance of sugar, vitamins, bioactive and mineral substances, which are very necessary for the human body, further increases their nutritional and healing value.

Along with acids, sugar has a strong effect on the taste of apples, because it reduces the acidity of acids. It has been determined that sugar and acids do not need to be mixed in a certain ratio for fruits to be sweet and pleasant, and the absolute amount of acids and sugars in the fruit does not determine the taste of the fruit.

Table 1 Effect of intensive orchard planting scheme on fruit quality of summer and early autumn apple varieties (2020-2022)

Varieties	Planting schemes and fruit size														
	4,0×2,5 м (control)			4,0×2,0 м				4,0×1,5 м				4,0×1,0 м			
	weight, g.	height, cm	diameter, cm	weight, g.	sweet relative, %.	height, cm	diameter, cm	weight, g.	gentle relative, %.	height, cm	diameter, cm	weight, g.	gentle relative, %.	height, cm	diameter, cm
Summer apple varieties															
"Pervenets in Samarkand" (st)	78,7	4,5	6,3	83,8	106,5	4,6	6,3	81,9	104,1	4,6	6,1	71,0	90,3	4,5	5,8
"Oydin"	149,7	5,7	7,3	164,3	109,7	5,5	7,5	159,3	106,4	5,8	7,2	123,8	82,7	5,7	7,0
"Elena"	159,8	6,2	7,3	169,0	105,7	6,5	7,5	161,1	105,8	6,3	7,4	133,9	86,5	5,6	6,5
Qizil Janoqi	86,9	5,6	5,9	88,0	101,3	5,5	5,6	87,9	101,1	5,6	5,7	85,8	98,7	5,1	5,2
"Rustami"	168,5	5,8	7,2	174,9	103,8	6,2	7,5	173,2	102,9	6,1	7,5	156,2	96,3	5,8	7,2
Mantet	79,2	4,5	5,8	80,8	102,0	5,2	6,2	80,1	101,1	4,5	5,8	77,6	98,0	4,9	5,7
Stark Erlist	103,3	5,9	6,6	104,5	101,2	5,5	6,9	103,5	100,9	5,4	6,9	90,6	87,7	5,4	6,3

Williams Pride	199,7	6,6	7,7	208,5	104,4	6,7	8,2	206,8	103,5	6,7	8,2	181,9	95,7	6,5	7,4
Pristine	109,0	5,2	7,0	112,5	103,2	5,5	7,2	111,9	102,7	5,1	6,7	107,1	96,5	4,9	6,7
Dayton	228,4	7,2	8,8	231,3	101,3	7,5	8,9	231,9	101,5	7,3	8,9	224,9	98,5	6,9	8,0
Vadimovka	233,9	7,1	8,6	236,9	101,3	7,2	8,9	237,4	101,5	7,3	8,7	229,9	98,3	7,0	8,2
EKF0.5	0,8	0,3	0,3	0,7	-	0,3	0,3	0,4	-	0,4	0,4	0,7	-	0,4	0,3
Sx	0,13	0,05	0,05	0,12	-	0,05	0,04	0,06	-	0,06	0,06	0,11	-	0,06	0,05
Early autumn apple varieties															
Red Delishes (st)	161,1	7,1	6,2	169,8	105,4	7,9	7,2	169,0	104,9	7,5	6,7	153,2	95,1	6,9	6,0
Renda	123,7	6,3	6,0	124,5	100,6	6,5	6,1	124,1	100,3	6,1	5,8	122,9	99,4	6,1	5,7
Candil Sinap	126,1	7,3	6,3	126,8	100,5	7,33	6,30	126,7	100,5	7,3	6,2	125,4	99,5	7,4	6,4
"Bolajon"	55,1	4,2	4,2	58,4	106,0	4,5	4,4	57,5	104,3	4,4	4,1	53,1	96,4	3,9	3,7
"Israel"	257,3	8,2	9,6	275,3	107,0	8,7	10,6	274,0	106,5	8,5	10,3	216,5	84,2	7,2	8,8
Farangiz	204,8	7,6	7,2	206,2	100,7	7,8	7,2	205,4	100,3	7,7	7,1	204,5	99,9	7,6	7,0
Prikubanskoe	251,1	7,0	8,2	265,5	105,7	7,5	8,7	261,1	104,0	7,3	8,4	241,1	96,0	7,0	7,9
Starking Delishes	122,8	4,7	6,8	124,6	101,5	4,8	6,6	124,5	101,4	4,8	6,9	120,7	98,3	4,7	6,6
Limonium	119,1	6,2	4,7	119,5	100,3	6,2	5,7	119,4	100,2	5,7	5,1	107,9	90,6	5,4	4,5
Renora Zimnyaya	175,4	5,9	7,3	184,8	105,3	6,3	7,4	182,8	104,2	6,4	7,5	166,7	95,0	5,6	6,2
Remo	154,9	5,9	6,6	155,9	100,6	6,6	7,3	155,7	100,5	6,4	7,0	150,1	99,5	6,2	6,5
Sunprice	125,9	5,1	6,4	130,8	103,9	5,8	7,1	126,1	103,1	5,2	6,4	118,7	97,3	5,0	5,7
Liberty Zimni	162,6	5,8	6,8	170,3	104,7	5,8	7,4	169,6	104,3	5,7	7,0	157,1	96,6	5,5	5,9
Wagner prizovoe	299,9	6,9	8,8	305,5	101,9	7,0	9,5	305,2	101,8	7,1	9,4	295,9	98,7	6,9	8,7
II-X-31	232,6	7,2	8,8	249,5	107,3	7,9	9,9	248,3	106,7	7,7	9,6	191,6	82,4	6,3	8,5
II-X-11	237,9	7,7	7,3	250,3	106,5	8,6	8,2	250,2	105,2	8,2	7,7	199,9	84,0	7,1	6,6
EKF0.5	0,9	0,3	0,3	0,4	-	0,3	0,2	0,5	-	0,2	0,3	0,7	-	0,4	0,4
Sx	0,15	0,06	0,06	0,08	-	0,05	0,04	0,08	-	0,04	0,05	0,13	-	0,06	0,07

Table 2 Effect of intensive orchard planting scheme on fruit quality of autumn and winter apple varieties (2020-2022)

Varieties	Planting schemes and fruit size														
	4,0×2,5 м (назорат)			4,0×2,0 м				4,0×1,5 м				4,0×1,0 м			
	weight, g.	height, cm	diameter, cm	weight, g.	gentle relative, %.	height, cm	diameter, cm	weight, g.	gentle relative, %.	height, cm	diameter, cm	weight, g.	gentle relative, %.	height, cm	diameter, cm
Autumn varieties															
King David (st)	178,0	7,4	7,3	185,6	104,3	7,5	7,5	183,5	103,1	7,1	7,2	168,2	96,2	6,8	6,6
Kubanskaya bagrennaya	253,0	6,3	8,1	259,9	102,7	6,4	8,8	258,9	102,3	6,3	8,5	240,6	97,3	5,6	7,8
Pamyat Esaulu	251,9	6,8	8,3	254,7	101,1	6,7	8,4	254,3	100,9	6,7	8,2	251,3	99,2	6,4	8,1
Florina	186,4	4,7	6,6	194,5	104,3	5,7	7,6	193,4	103,7	5,3	6,8	146,4	95,4	4,7	6,4
EKF 0.5	0,6	04	01	0,7	-	0,2	0,1	1,0	-	0,1	0,1	0,3	-	0,1	0,1
Sx	0,10	0,06	0,02	0,11	-	0,03	0,02	0,16	-	0,02	0,02	0,05	-	0,02	0,02
Winter varieties															
"Nafis" (st)	235,4	7,3	8,2	248,9	105,7	7,5	8,3	244,9	104,0	7,4	8,4	225,8	93,2	6,8	7,8
Fuji	184,4	6,2	7,4	193,4	104,9	6,3	7,4	189,9	103,0	6,3	7,3	174,2	94,5	5,9	7,0
Mutsu	269,1	6,5	7,6	285,9	106,2	7,8	8,6	284,9	105,3	6,7	7,8	257,3	92,5	6,5	7,5

Goldrush	125,9	5,3	6,2	128,3	101,9	5,7	6,4	123,9	101,6	5,4	6,3	120,9	98,4	4,7	5,7
EKF0.5	1,2	0,2	0,1	0,7	-	0,1	0,1	1,1	-	0,1	0,1	0,6	-	0,1	0,1
Sx	0,19	0,02	0,02	0,10	-	0,01	0,02	0,17	-	0,02	0,02	0,09	-	0,02	0,02

However, as the sugar content increases and the acid content reaches a certain level, the fruit tastes better. In addition, the presence of complex esters, aldehydes, flavoring agents, pectin and other substances in the fruit, as well as its wateriness, also affect its taste.

One of the indicators determining the quality of fruits is their chemical composition, which depends on the type and variety of fruits on the one hand, and on the other hand, their growth conditions. The abundance of sugar, vitamins, bioactive and mineral substances, which are very necessary for the human body, further increases their nutritional and healing value.

Along with acids, sugar has a strong effect on the taste of apples, because it reduces the acidity of acids. It has been determined that sugar and acids do not need to be mixed in a certain ratio for fruits to be sweet and pleasant, and the absolute amount of acids and sugars in the fruit does not determine the taste of the fruit. However, as the sugar content increases and the acid content reaches a certain level, the fruit tastes better. In addition, the presence of complex esters, aldehydes, flavoring agents, pectin and other substances in the fruit, as well as its wateriness, also affect its taste.

As the fruit ripens, the absolute amount of acids in them increases. However, as the fruit weight increases and cell juice increases, the amount of acids decreases. As the apple ripens, the sugar content increases, while the amount of starch, cellulose and acids decreases. It is possible to achieve a certain level of productivity in apple trees, to increase the size of fruits, attractiveness and other qualities, by planting trees in a certain planting scheme. In an intensive garden, if the appropriate planting scheme is not chosen based on the strength of the grafts and trees, the fruit will not ripen on time, the color characteristic of the variety will not enter them, the sugar content will be low, the taste will not be sweet and pleasant due to the high acidity, and the size of the fruits will be small.

In the studies conducted on the study of the effect of the planting scheme on the chemical composition of fruits in the intensive garden, it was found that the amount of sugar and dry matter in the fruits decreased, and the acidity and total water content increased in the variants with a reduced feeding area compared to the control. In the summer varieties, the earliest Mantet and Stark Erlist varieties, in the control version, the sugar content in the fruits was on average 9.4-9.9%, while in the 4.0x2.0 m plot, this indicator increased by 1.1-1.3%, and the decrease in acidity was 0.17-0.29%. In these varieties, it was found that the amount of sugar content of fruits decreased by 0.4%, and the amount of acidity increased by 0.08-0.09%.

In the local varieties "Oydin" and "Elena" compared to the control in the 4.0x2.0 m scheme, the sugar content of the fruit was the highest 12.3%, while in the 4.0x1.0 m scheme it was sharply 1.5-2.2% It was found that decreased, and the amount of acidity increased by 0.35-0.50% with the highest difference. The sugar content of the promising, large-fruited, introduced varieties Dayton and Vadimovka was 12.3% in the 4.0x2.0 m plot, while this indicator decreased by 0.1-0.4% in the 4.0x1.0 m plot, it was found that it decreased, and the amount of acidity increased by 0.14-0.24%.

In the early autumn apple variety "Israel" and II-X-31, II-X-11 hybrids, the sugar content of the fruit increased by 1.1-1.4% in the 4.0x2.0 m plot compared to the control, while In the 4.0x1.0 m scheme, it was found that it decreased by 0.2-0.5%, and the amount of acidity increased by 0.09-0.16%. The decrease in the amount of sugar was 0.1-0.2% with the least difference in the 4.0x1.0 m scheme in the varieties Renda, Kandil Sinap, "Bolajon", "Farangiz", Starking Delishes and Wagnera prizovoe. In these varieties, the increase in acidity was 0.1-0.2% with the lowest difference in the 4.0x1.0 m planting scheme. It was found that in autumn and winter varieties, the reduction of the feeding area in comparison to the control caused the decrease in the amount of sugar in the fruit and the increase in the acidity. The reduction of the nutritional area not only showed its effect on the size of the fruits, but also showed a clear difference in their appearance and biochemical composition, entering into the variety-specific color. In the case of planting varieties with a large canopy size and tall trees in a 4.0x1.0 m scheme, most of the fruits are left in the shade, so the fruits are not ripe, the color is low,

the flesh is hard, the size is small, the taste is sour, and it does not meet the standard requirements and does not show signs characteristic of the variety (Table 3).

Modern horticulture is focused on intensive technologies, the main elements of which include economic valuable traits of varieties, their cultivation on low cuttings and dense planting schemes [1; 31–40-p.]. When building a garden, choosing a suitable place for it, using varieties suitable for soil and climate conditions, choosing a planting scheme according to the strength of grafting and tree growth are the most important measures in building a garden, which ensure high-quality harvest for many years. Planting pattern or proper density directly affects the productivity of orchards [10; 57–81-p.], [2; 103–117-p.].

Table 3 Effect of planting scheme on the chemical composition of fruits in an intensive orchard (2020-2022)

Varieties	Chemical composition of fruits, %															
	sugar substance	acidity	total water content	dry matter	sugar substance	acidity	total water content	dry matter	sugar substance	acidity	total water content	dry matter	sugar substance	acidity	total water content	dry matter
	4,0×2,5 м (control)				4,0×2,0 м				4,0×1,5 м				4,0×1,0 м			
Summer apple varieties																
"Pervenets in Samarkand" (st)	9,3	0,95	86,6	13,4	9,6	0,92	86,0	14,0	9,5	0,94	86,4	13,6	9,2	0,97	86,6	13,4
"Oydin"	11,3	0,51	85,7	14,3	12,3	0,27	84,5	15,5	12,2	0,30	84,8	15,2	10,8	0,77	85,5	14,5
"Elena"	11,2	0,69	85,8	14,5	12,3	0,47	85,0	15,0	11,7	0,59	85,5	14,5	10,1	0,82	85,9	14,1
Qizil Janoqi	10,9	0,37	86,8	13,2	12,0	0,26	86,1	13,9	11,5	0,28	86,4	13,6	10,3	0,48	87,0	13,0
"Rustami"	11,5	0,85	86,5	13,5	12,1	0,76	85,8	14,2	12,0	0,82	86,2	13,7	10,4	0,89	86,8	13,2
Mantet	9,4	0,86	88,0	12,0	10,5	0,69	87,5	12,5	9,9	0,75	87,8	12,2	9,0	0,95	88,2	11,8
Stark Erlist	9,9	0,76	88,3	11,7	11,2	0,47	87,5	12,5	10,6	0,53	87,9	12,1	9,5	0,84	88,3	11,7
Williams Pride	11,4	0,60	86,6	13,4	12,2	0,49	86,6	13,4	12,0	0,54	86,5	13,5	11,0	0,59	86,9	13,1
Pristine	12,1	0,84	85,4	14,6	12,3	0,76	85,2	14,8	12,1	0,81	85,0	15,0	11,4	0,92	85,3	14,7
Dayton	12,2	0,57	85,1	14,9	12,3	0,52	84,8	15,2	12,2	0,63	85,3	14,7	12,2	0,66	85,8	14,2
Vadimovka	12,0	0,67	85,9	14,0	12,3	0,46	85,0	15,0	12,1	0,53	85,8	14,2	11,9	0,70	86,2	13,8
Early autumn apple varieties																
Red Delishes (st)	12,0	0,55	81,6	18,4	12,6	0,53	81,5	18,5	12,4	0,54	81,7	18,3	11,9	0,55	82,2	17,8
Renda	11,6	0,42	85,4	14,6	11,8	0,39	84,9	15,1	11,6	0,40	85,0	14,8	11,4	0,44	85,5	14,5
Candil Sinap	12,1	0,51	84,6	15,4	12,2	0,55	83,9	16,1	12,1	0,53	84,2	15,8	12,0	0,53	84,7	15,3
"Bolajon"	11,3	0,34	82,7	17,3	11,6	0,33	82,5	17,5	11,5	0,34	82,6	17,4	11,0	0,35	82,9	17,1
"Israel"	11,6	0,67	83,4	16,6	12,7	0,53	82,5	17,5	11,9	0,59	83,2	16,8	11,3	0,76	83,8	16,2
Farangiz	12,0	0,42	84,0	16,0	12,5	0,41	83,8	16,2	12,4	0,43	83,9	16,1	11,8	0,43	84,3	15,7
Prikubanskoe	11,9	0,63	84,9	15,1	12,4	0,60	84,6	15,4	12,1	0,63	85,0	15,0	11,5	0,72	85,6	14,4
Starking Delights	12,4	0,39	81,8	18,2	12,7	0,37	81,7	18,3	12,4	0,38	81,7	18,3	12,3	0,39	81,7	18,3
Limonium	10,9	0,65	83,6	16,4	11,7	0,45	82,8	17,2	11,3	0,57	83,1	16,9	10,3	0,77	84,2	15,8
Renora Zimnyaya	12,4	0,67	81,7	18,3	13,2	0,55	81,8	18,2	12,7	0,60	81,7	18,3	12,0	0,72	82,0	18,0
Remo	12,2	0,55	83,4	16,6	12,8	0,46	83,0	17,0	12,6	0,56	83,1	16,9	11,7	0,62	83,9	16,1
Sunprice	11,2	0,56	87,8	12,2	12,1	0,46	86,6	13,3	11,5	0,54	87,8	12,2	10,7	0,67	86,2	11,8
Liberty Zimni	12,0	0,46	83,7	16,3	12,3	0,43	83,2	16,8	12,1	0,46	83,8	16,2	10,6	0,71	83,7	16,3
Wagner prizovoe	12,0	0,47	82,8	17,2	12,4	0,41	82,4	17,8	12,2	0,45	82,6	17,4	11,8	0,49	84,2	16,5
II-X-31	12,2	0,45	83,3	16,7	13,4	0,32	82,7	17,3	12,8	0,39	83,1	16,9	12,0	0,61	84,0	16,0
II-X-11	10,8	0,63	85,5	14,5	12,2	0,46	85,3	14,7	11,6	0,56	85,7	14,5	10,3	0,77	85,7	14,3
Autumn varieties																
King David (st)	10,5	0,75	83,9	16,1	11,9	0,59	82,2	17,8	11,3	0,71	83,7	16,3	10,6	0,82	84,0	16,0
Kubanskaya bagrennaya	11,6	0,67	82,8	17,2	12,2	0,64	83,2	16,8	12,1	0,66	83,6	16,4	10,6	0,77	84,1	15,9
Pamyat Esaulu	11,8	0,64	82,5	17,5	13,7	0,47	81,3	18,7	12,5	0,51	82,5	17,5	11,1	0,66	83,4	16,6
Florina	10,8	0,75	84,0	16,0	12,7	0,59	82,5	17,5	11,4	0,68	83,9	16,1	10,4	0,83	84,5	15,5
Winter varieties																

"Nafis" (st)	12,0	0,60	83,3	16,7	12,9	0,51	82,2	17,8	12,5	0,53	83,3	16,7	10,1	0,74	83,9	16,1
Fuji	11,1	0,70	82,6	17,4	12,6	0,64	82,9	17,1	11,3	0,80	83,3	16,7	10,6	0,82	83,7	16,3
Mutsu	11,5	0,68	83,5	16,5	12,8	0,56	83,1	16,9	12,3	0,52	82,5	17,5	11,0	0,67	84,0	16,0
Goldrush	12,1	0,73	84,9	15,1	12,3	0,52	83,3	16,7	12,1	0,63	83,9	16,1	11,9	0,84	85,7	14,3

Intensive groves can have a density of up to 12,000 trees per hectare. The basis of such gardens are clone grafts with slow growth, which belong to the group of short, half-sized and medium-sized. [10; 3–81-p.], [9; 21–47-p.], [4; 3–30-p.].

The most important thing in the organization of intensive gardens is the correct choice of tree planting scheme. The positive side of planting trees by reducing the number of feeding areas is that the phytosynosis process begins to have a positive effect on them faster and it is possible to get a high yield from the garden in the first years, and the negative side is that placing trees in a scheme of planting more than the optimal amount causes competition between them, increases the overall productivity, and causes low-quality fruit. Also, when they are planted in a large planting scheme, they do not give the expected result, because the first harvest is late and low, and a lot of time and labor is spent to ensure that the garden enters a productive harvest.

In the study of the influence of the planting scheme on the yield of apple varieties in an intensive orchard, the yield of a 6-year-old orchard grown on M-IX grafting of apple was analyzed. According to the obtained results, the productivity indicators obtained from one tree differed between the varieties, in the variants planted in 4.0x2.0 m and 4.0x1.5 m schemes, the yield from a tree increased compared to the control, but due to the reduction of the feeding area, in all varieties, the yield from one tree increased, it was observed that the obtained productivity decreased, and the amount per hectare increased. The reason for this is the increase of the number of bushes per hectare to 1000-2500.

In the option of planting summer varieties in a 4.0×2.5 m scheme, the largest yield from one tree was "Oydin" (35.8 kg.), "Rustamiy" (39.2 kg.), Williams Pride (26.8 kg.), Dayton (32.3 kg.) and Vadimovka (34.7 kg.) varieties, and it was 26.8-39.2 t/ha, respectively. In the same varieties planted in a 4.0x2.0 m scheme, the yield from one tree increased by 0.6-2.5%, and when the number of seedlings was increased to 250 per hectare, the yield was 34.0-49.4 t/ha. Or the yield was 26-27.9% more per hectare compared to the variant planted in the control scheme. In these varieties, in the 4.0x1.5 m and 4.0x1.0 m plots, the yield per tree decreased, but the yield per hectare was 44.9-94.5 t/ha. In early autumn varieties, the control planted in a 4.0×2.5 m scheme yield per tree "Israel" (28.2 kg.), Prikubanskoe (38.4 kg.), Starking Delishes (29.0 kg.), Varieties Renora Zimnyaya (24.4 kg.), Sunprice (28.9 kg.), Liberty zimniy (26.1 kg.), Wagnera prizovoe (28.8 kg.) and II-X-31 (26.2 kg .), recorded a high result in II-X-11 (28.8 kg.) hybrids, according to these varieties, the yield was 24.4-38.4 t/ha per hectare (Table 4).

Table 4 The effect of the intensive orchard planting scheme on the productivity of apple varieties (2020-2022)

Varieties	Productivity							
	kg/tree	t/ha	kg/tree	t/ha	kg/tree	t/ha	kg/tree	t/ha
	4,0×2,5 м.(con)		4,0×2,0 м.		4,0×1,5 м.		4,0×1,0 м.	
Summer apple varieties								
"Pervenets in Samarkand" (st)	17,9	17,9	18,3	22,9	18,0	30,0	17,2	42,9
"Oydin"	35,8	35,8	36,7	45,8	35,9	59,9	30,3	75,6
"Elena"	14,5	14,5	14,7	18,3	14,4	23,9	12,3	30,8
Qizil Janoqi	14,4	14,4	14,6	18,2	14,5	24,1	14,3	35,9
"Rustami"	39,2	39,2	39,6	49,4	39,4	65,6	37,8	94,5
Mantet	16,8	16,8	17,4	21,7	17,1	28,5	16,9	42,3
Stark Erlist	16,6	16,6	16,8	21,0	16,7	27,9	16,6	41,5
Williams Pride	26,8	26,8	27,2	34,0	27,0	44,9	26,5	66,2
Pristine	12,6	12,6	12,9	16,2	12,6	21,0	11,9	29,7
Dayton	32,3	32,3	32,9	41,2	32,5	54,2	31,3	78,3
Vadimovka	34,7	34,7	34,9	43,6	34,7	57,9	32,7	81,7
EKF0.5	0,3	0,3	0,4	0,5	0,5	0,9	0,5	1,2

Sx	0,05	0,05	0,06	0,08	0,09	0,14	0,08	0,20
Early autumn apple varieties								
Red Delishes (st)	15,3	15,3	16,6	20,7	15,6	26,0	14,9	37,3
Renda	18,2	18,2	18,6	23,3	18,3	30,4	17,9	44,8
Candil Sinap	8,0	8,0	7,7	9,6	7,4	12,4	7,2	18,0
"Bolajon"	17,1	17,1	18,3	22,8	17,8	29,6	17,3	43,3
"Israel"	28,7	28,7	30,9	38,6	29,8	49,7	26,3	65,8
Farangiz	14,8	14,8	14,9	18,6	14,4	23,9	14,4	36,0
Prikubanskoe	38,4	38,4	39,9	49,8	39,7	66,1	38,3	95,8
Starking Delishes	29,0	29,0	31,0	38,7	29,7	49,6	29,3	73,3
Limonium	13,1	13,1	13,9	17,4	12,1	20,1	9,7	24,3
Renora Zimnyaya	24,4	24,4	24,9	31,1	24,6	41,0	21,3	53,3
Remo	19,8	19,8	20,3	25,4	20,0	33,4	19,7	49,3
Sunprice	28,9	28,9	33,3	41,6	25,0	41,6	22,9	57,3
Liberty Zimni	26,1	26,1	27,3	34,1	27,0	45,0	21,7	54,3
Wagner prizovoe	28,8	28,8	29,3	36,6	28,9	48,2	28,7	71,8
II-X-31	26,2	26,2	28,7	35,9	20,8	34,6	15,1	37,8
II-X-11	28,8	28,8	29,8	37,3	28,9	48,2	18,8	47,0
EKF0.5	0,3	0,3	0,3	0,4	0,3	0,5	0,6	1,4
Sx	0,05	0,05	0,05	0,07	0,05	0,09	0,10	0,24
Autumn varieties								
King David (st)	32,9	32,9	36,5	45,7	35,8	59,7	33,2	83,0
Kubanskaya bagrennaya	37,4	37,4	37,8	47,2	37,7	62,8	36,5	91,2
Pamyat Esaulu	19,4	19,4	21,0	26,2	20,1	33,5	19,2	48,0
Florina	29,8	29,8	35,2	43,9	30,5	50,9	25,1	62,7
EKF0.5	0,4	0,4	0,5	0,6	0,4	0,7	0,7	1,6
Sx	0,07	0,07	0,07	0,09	0,06	0,10	0,10	0,26
Winter varieties								
"Nafis" (st)	37,0	37,0	38,4	48,0	37,6	62,6	30,2	75,5
Fuji	18,3	18,3	18,6	23,3	17,7	29,5	16,6	41,5
Mutsu	19,3	19,3	20,4	25,5	19,7	32,9	14,2	43,0
Goldrush	34,8	34,8	35,5	44,4	35,1	58,6	32,8	82,0
EKF0.5	0,6	0,6	0,3	0,3	0,3	0,5	0,5	1,2
Sx	0,09	0,09	0,04	0,05	0,05	0,08	0,07	0,18

In the variant planted in the 4.0x2.0 m scheme, the yield from the tree increased by 2.0-3.9%, in the 4.0x1.5 m scheme by 0.8-3.4%, and in the 4.0x1.0 m scheme, It was found that it decreased by 0.3-12.7%

The King David variety, which was taken as a control among the studied autumn varieties, is a high-yielding variety and occupies a certain place in the gardens of the Republic. This variety has a very high index in all schemes. Among the varieties of this group, the varieties with a high yield index in the control scheme recorded a high index in other schemes, including the most densely planted (4.0×1.0 m.) scheme, including Kubanskaya bagrennaya variety, it was found that although the yield from one bush decreased by 2.4% compared to the control, the yield from one hectare increased by 2.4 times. In the Florina variety, which has a wide crown and large trees, it was found that the productivity of one tree decreased by 15.8% compared to the control in the 4.0x1.0 m plot, and the productivity per hectare was 62.7 t/ha.

In winter varieties, like the varieties of the previous group, the productivity index was higher in the 4.0x2.0 m and 4.0x1.5 m schemes compared to the control, and decreased in the version planted in the 4.0x1.0 m scheme. "Nafis" (st) and Goldrash varieties were more productive than others in the control option, and the yield from one tree was 37.0 and 34.8 kg/tree. In the scheme of 4.0x2.0 m, this indicator increased by 2-4%, in the scheme of 4.0x1.5 m by 0.8-1.6%, in the scheme of 4.0x1.0 m by 5.8-18.4% was found to be reduced.

It should be noted that the effect of any agrotechnical event is ultimately focused on obtaining a high-quality and high yield, in the research, local "Oydin" (36.7 kg/tree), "Rustami" (39.6 kg/tree), "Israel" (30.9 kg/tree), introduced Dayton (32.9 kg/tree), Vadimovka (34.9 kg/tree), Prikubanskoe (39.9 kg/tree), Sunprice (33.3 kg/tree), Kubanskaya bagrennaya (37.8 kg/tree), Florina (35.2 kg/tree)

, Goldrash (35.5 kg/tree) varieties and II-X-31, II-X-11 hybrids planted in a 4.0×2.0 m scheme, the yield from one tree and the quality of fruits were higher compared to other varieties and schemes.

Summary. As a result of research on the effect of planting scheme on fruit quality of apple varieties domestic varieties "Oydin", "Rustami", "Israel", "Nafis" and introduction Williams Pride, Dayton, Vadimovka, Prikubanskoe, King David, Florina, Starking Delishes, Sunprice, Kubanskaya bagrennaya, Goldrash varieties When planted in a plot of 4.0x2.0 m, the marketability of the fruits is high, due to the increase in the size of the fruits, the weight increased by 1.3-9.7%, and the amount of sugar in the fruit increased by 0.1-1.1%, and the amount of organic acids found that it decreased by 0.1-0.2%.

As the planting pattern of apple trees decreased, the yield per tree decreased, and the yield per hectare increased due to the increase in the number of trees. Summer "Oydin" (45.8 t/ha), "Rustamiy" (49.4 t/ha), Williams Pride (34.0 t/ha), Dayton (41 ,2 t/ha), the highest 34.0-49.4 t/ha in Vadimovka (43.6 t/ha), early autumn "Israel" (38.6 t/ha), Prikubanskoe (49.8 t /ha), 38.6-49.8 t/ha in Starking Delishes (38.7 t/ha), Sunprice (41.6 t/ha), autumn King David (45.7 t/ha), Kubanskaya bagrennaya (47.2 t/ha), and Florina (43.9 t/ha) 43.9-47.2 t/ha, winter Nafis (48.0 t/ha) and Goldrash (44.4 t /ha) yield of 44.4-48.0 t/ha was recorded.

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